3. UPPER CRETACEOUS POLLEN GRAINS FROM EGYPT IV.

M. KEDVES

Cell Biological and Evolutionary Micropaleontological Laboratory of the Department of Botany of the J.A. University, H-6701, P.O. Box 993, Szeged, Hungary

Abstract

This paper deals with the taxa of the following form-genera isolated from the Senonian sediments of Egypt: *Retitricolporites* (VAN DER HAMMEN 1956) VAN DER HAMMEN et WIJMSTRA 1964 - end, *Retibrevitricolporites* LEGOUX 1978, *Ilexpollenites* THIERGART 1937 (in RAATZ 1937), *Verrutricolporites* VAN DER HAMMEN et WIJMSTRA 1964, *Gemmatricolporites* LEIDELMEYER 1966, *Granotricolporites* KEDVES 1978, *Punctatricolporites* n. fgen., *Psilatricolporites* VAN DER HAMMEN 1956 ex PIERCE 1961, *Cupuliferoipollenites* R. POTONIÉ 1960, *Fususpollenites* KEDVES 1978, *Cyrillaceaepollenites* (MÜRRIGER et PFLUG 1951) R. POTONIÉ 1960, *Striatricolporites* (VAN DER HAMMEN 1956) LEIDELMEYER 1966, *Nagyipollis* KEDVES 1962, *Tubistephanocolpites* SALAMI 1984 emend. SCHRANK 1994. New taxa described in this paper: *Retibrevitricolporites legouxae* n. fsp., *Ilexpollenites aegypticus* n. fsp., *I. farafraensis* n. fsp., *Granotricolporites potoniei* n. fsp., *G. kirchheimerii* n. fsp., *G. druggii* n. fsp., *G. stanleyi* n. fsp., *Punctatricolporites africanus* n. fgen. et fsp., *P. semipunctatus* n. fsp., *P. farafraensis* n. fsp., *Psilatricolporites magloirae* n. fsp., *P. aegypticus* n. fsp., *Nagyipollis farafraensis* n. fsp., *Tubistephanocolpites schrankii* n. fsp.

Key words: Palynology, fossil, *Angiospermatophyta*, Upper Cretaceous, Egypt.

9. *Retitricolporites* fsp.
(Plate 3.1., figs. 1,2)

Description: Amb circular, surface finely reticulate. The lumina of the reticulum are 0.2-0.3 µm, in diameter and the muri about 0.2 µm wide. The exine is 2-2.5 µm thick, the infratectum is thicker than the tectum and the foot layer; T/I/F = 1/2-2.5/1. Furrows asymmetrical, one is shorter than the two others, and do not reach the poles. There are characteristic cavernae around the furrows, which are 2-3 µm wide near the endoapertures, and about 1 µm wide at the end of the furrows. Endoaperture very narrow, relatively long transversal furrow, 0.3 x 3-3.5 µm.

Diameter: 20 µm.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Abu Minquar (4-3) infrequent, Kharga (1-39) common.

Form-genus: *Retibrevitricolporites* LEGOUX 1978

This form-genus was described on the basis of a palynological study of the Neogene sediments of Nigeria. Several SEM pictures of these pollen grains were also published.

1. *Retibrevitricolporites legouxae* n. fsp.
(Plate 3.1., figs. 3,4)

Diagnosis: Amb circular in polar view. Surface very finely reticulate, sometimes foveolate. The lumen of the reticulum is 0.15-0.25 µm, the muri width is about 0.2 µm. The exine is 0.8-1.3 µm thick, the tectum, infratectum, and the foot layer are equal; T/I/F = 1/1/1. Structure intrabaculate. Furrows are about 10 µm long, around them the cavernae are thin and about 2.5 µm wide. Endoapertures about 6 µm long, 1-1.5 µm wide transversal furrows.

Diameter: 18 µm; 16-20 µm.

Holotype: Plate 3.1., figs. 3,4, slide: Kharga-1-39-2, cross-table number: 14.5/107.5.

Locus typicus: Kharga, Maestrichtian, Nubia Sandstone.

Stratum typicum: clay.

Derivatio nominis: In honour of Dr. O. LEGOUX.

Differential diagnosis: *R. obodoensis* LEGOUX 1978 is triangular, convex in polar view, with a slightly prominent germinal area.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-1) infrequent, Kharga (1-39) infrequent, Kharga (1-28) infrequent, Maestrichtian, fm. indet.: Oweina (3) infrequent.

Form-genus: *Ilexpollenites* THIERGART 1937 (in RAATZ 1937)

Concerning the history of the genus *Ilex*, H. MARTIN (1977) wrote the following; p. 655: "The pollen of *Ilex* is very distinctive and fossil specimens can be related to it with certainity. There is an undescribed fossil species in the Turonian (earliest Upper Cretaceous) of south-eastern Australia, where *Ilex* predates the first appearance of *Nothofagus*. *Ilexpollenites* spp. are usually present from Maestrichtian (latest Upper Cretaceous) to late Miocene." LOBREAU-CALLEN (1975) pointed out, that the variation in size of the *Ilex* species is related to longitude, latitude, altitude and to the climate.

1. *Ilexpollenites margaritatus* (R. POTONIÉ 1934) RAATZ 1937 forma *medius* PFLUG et THOMSON 1953, *Aquifoliaceae, Ilex*
(Plate 3.1., figs. 5-8)

Description: Amb ellipsoidal. Ornamentation clavate, the elements are about 3 µm high, the diameter of the capituli is 1.5-2.5 µm. The foot layer is relatively thin. The furrows do not reach the poles. Around the pole there are cavernae which are 2 µm in width. The endoapertures are not clearly discernible because of the clavate sculpture.

Polar axis: 22 µm; 20-25 µm.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Kharga (1-28) infrequent.

Remarks: *I. margaritatus* f. *medius* is a relatively very common pollen type of the Tertiary spore-pollen assemblages of the Northern Hemisphere.

2. *Ilexpollenites aegypticus* n. fsp.
(Plate 3.1., figs. 9,10)

Diagnosis: Amb ellipsoidal. Surface clavate. The maximal thickness of the exine is 2.5-3 µm. The capituli of the clavae are 1-1.8 µm, furrows are long, and reach the poles. They converge near the poles. The cavernae are 2-3 µm in width. Endopores circular, and 3-4 µm in diameter.

Polar axis: 31 µm; 26-32 µm.

Holotype: Plate 3.1., figs. 7,8, slide: Farafra-6-2-1-10, cross-table number: 15.5/112.6.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clay.

Derivatio nominis: From Egypt.

Differential diagnosis: *I. deliciosus* SAH 1967 is larger (40-48 µm) than our new species.

Botanical affinity: *Aquifoliaceae, Ilex.*

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-1) infrequent.

3. *Ilexpollenites farafraensis* n. fsp.
(Plate 3.1., figs. 11-14)

Diagnosis: Amb ellipsoidal or sexangular in polar view. Surface clavate. The exine is 1.5-2 µm thick, the capituli are 1-1.3 µm in size. The furrows generally do not reach the poles, the cavernae are 2.5-3 µm in width. Endopori circular, and generally 2-3 µm in diameter.

Polar axis or maximum size: 22 µm; 21-25 µm.

Holotype: Plate 3.1., figs. 13,14, slide: Farafra-6-2-1-10, cross-table number: 15.3/113.6.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clayey brown coal.

Derivatio nominis: From Farafra.

Differential diagnosis: The capituli of *I. erdtmani* KEDVES 1978 are larger (0.5-1 µm) than those of *I. farafraensis* n. fsp.

Botanical affinity: *Aquifoliaceae, Ilex.*

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) common, Farafra (11) common.

Form-genus: *Verrutricolporites* VAN DER HAMMEN et WIJMSTRA 1964

Tricolporate pollen grains, sculpture verrucate.

1. *Verrutricolporites bignoti* (GRUAS-CAVAGNETTO 1979) n. comb.
(Plate 3.1., figs. 15-18)

Syn.: 1976 *Tricolporopollenites bignoti* GRUAS-CAVAGNETTO, p. 33, pl. 10, figs. 14,15.

Description: Amb ellipsoidal. Surface verrucate. The basal diameter of the sculptural elements is 2-2.5 µm, and they are 0.5-0.7 µm high. The exine is 0.7-0.9 µm thick, the infratectal layer is thicker than the tectum and the foot layer; T/I/F = 1/2/1. Structure intrabaculate. The furrows reach the poles, around them there are narrow (0.5 µm) cavernae. Tiny circular endopori, which are 1.5 µm in diameter.

Polar axis: 18 µm; 16-22 µm.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) infrequent.

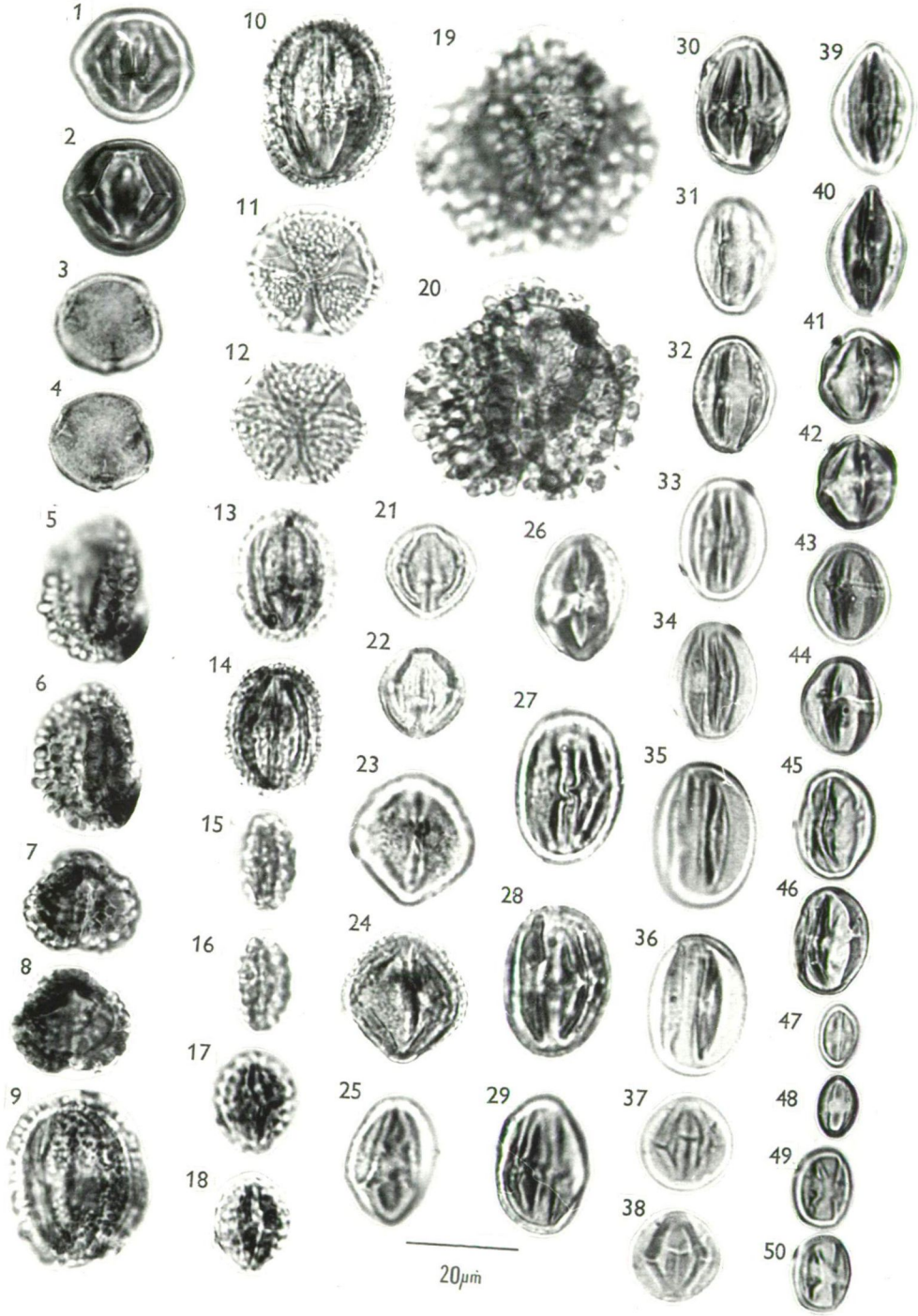
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
20μm

Plate 3.1.

Form-genus: *Gemmatricolporites* LEIDELMEYER 1966

The gemmate sculpture is very characteristic of these tricolporate pollen grains. HUANG (1980) established the *Rutaceae* as the botanical affinity for his new species from the Miocene of Taiwan.

1. *Gemmatricolporites* fsp.
(Plate 3.1., figs. 19,20)

Description: Isodiametric pollen grains, with gemmate sculpture. The diameter of the sculptural elements is 1.5-3 µm. The exine is 2.5-3.5 µm thick, the infratectal layer is the thickest between the ectexine layers; T/I/F = 1/2-3/1. Structure intrabaculate. The furrows reach the poles, the cavernae are 2-3 µm in width. The endoapertures are not easily discernible because of the sculpture, but they appear to be elliptical.

Diameter: 42 µm.

Remarks: Similar to *G. divaricatus* LEIDELMEYER 1966 from the Lower Paleogene of Guiana, but the Egyptian specimen is larger.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-1) infrequent.

Plate 3.1.

1,2. *Retitricolporites* fsp., slide: Abu Minquar-4-3-6, cross-table number: 19.6/112.5.
3,4. *Retibrevitricolporites legouxae* n. fsp., slide: Kharga-1-39-2, cross-table number: 14.5/107.5.
5,6. *Ilexpollenites margaritatus* (R. POTONIÉ 1934) RAATZ 1937 forma *medius* PFLUG et THOMSON 1953, *Aquifoliaceae, Ilex*, slide: Kharga-1-28-1, cross-table number: 4.5/110.8.
7,8. *Ilexpollenites margaritatus* (R. POTONIÉ 1934) RAATZ 1937 forma *medius* PFLUG et THOMSON 1953, *Aquifoliaceae, Ilex*, slide: Kharga-1-35-5, cross-table number: 14.5/105.5.
9,10. *Ilexpollenites aegypticus* n. fsp., *Aquifoliaceae, Ilex*, slide: Farafra-6-2-1-10, cross-table number: 15.5/112.6.
11,12. *Ilexpollenites farafraensis* n. fsp., *Aquifoliaceae, Ilex*, slide: Farafra-6-2-2-4, cross-table number: 9.9/114.6.
13,14. *Ilexpollenites farafraensis* n. fsp., *Aquifoliaceae, Ilex*, slide: Farafra-6-2-1-10, cross-table number: 15.3/113.6.
15,16. *Verrutricolporites bignoti* (GRUAS-CAVAGNETTO 1970) n. comb., slide: Farafra-6-2-2-6, cross-table number: 9.4/105.8.
17,18. *Verrutricolporites bignoti* (GRUAS-CAVAGNETTO 1970) n. comb., slide: Farafra-6-2-1-3, cross-table number: 10.1/118.3.
19,20. *Gemmatricolporites* fsp., slide: Farafra-6-2-1-1, cross-table number: 19.1/115.8.
21,22. *Granotricolporites potoniei* n. fsp., slide: Farafra-6-2-2-4, cross-table number: 7.7/116.3.
23,24. *Granotricolporites kirchheimerii* n. fsp., slide: Abu Minquar-4-3-4, cross-table number: 7.3/108.4.
25,26. *Granotricolporites druggii* n. fsp., slide: Farafra-6-2-2-6, cross-table number: 17.1/101.4.
27,28. *Granotricolporites druggii* n. fsp., slide: Farafra-6-2-1-6, cross-table number: 14.4/106.3.
29,30. *Granotricolporites druggii* n. fsp., slide: Farafra-6-2-1-6, cross-table number: 7.6/109.6.
31,32. *Granotricolporites stanleyi* n. fsp., slide: Abu Minquar-4-3-8, cross-table number: 17.2/115.6.
33,34. *Punctatricolporites africanus* n. fsp., slide: Abu Minquar-4-3-6, cross-table number: 8.3/103.3.
35,36. *Punctatricolporites africanus* n. fsp., slide: Farafra-6-2-2-10, cross-table number: 11.8/103.1.
37,38. *Punctatricolporites semipunctatus* n. fsp., slide: Farafra-6-2-2-7, cross-table number: 7.2/104.3.
39,40. *Punctatricolporites farafraensis* n. fsp., slide: Farafra-6-2-1-9, cross-table number: 9.4/111.8.
41,42. *Psilatricolporites magloirae* n. fsp., slide: Farafra-6-2-1-10, cross-table number: 4.9/114.3.
43,44. *Psilatricolporites magloirae* n. fsp., slide: Abu Minquar-4-3-10, cross-table number: 20.2/106.6.
45,46. *Psilatricolporites aegypticus* n.fsp., slide: Abu Minquar-4-3-5, cross-table number: 19.6/106.4.
47,48. *Cupuliferoipollenites insleyanus* (TRAVERSE 1955) R. POTONIÉ 1960, *Fagaceae* cf. *Castanea*, slide: Kharga-1-39-3, cross-table number: 12.7/110.3.
49,50. *Cupuliferoipollenites* cf. *oviformis* (R. POTONIÉ 1931a) R. POTONIÉ 1960, *Fagaceae*, cf. *Castanea*, slide: Farafra-6-2-1-2, cross-table number: 17.8/98.8.

Form-genus: *Granotricolporites* KEDVES 1978
These pollen grains are tricolporate, with a granulate surface.

1. *Granotricolporites potoniei* n. fsp.
(Plate 3.1., figs. 21,22)

Diagnosis: Amb circular or elliptical. Surface finely granulate, the size of the sculptural elements is about 0.2 µm. The exine is 0.7-0.9 µm thick. The tectum, infratectal layer, and the foot layer are of equal thickness. The furrows are asymmetrical and they converge in the polar direction. The caverna is 0.7-0.9 µm wide. Around the furrows there are short plicae (pseudo-furrows). The endoapertures are meridionally elongated short colpi (rugae), 0.5 x 3-3.5 µm.

Polar axis: 17 µm; 15-20 µm.

Holotype: Plate 3.1., figs. 21,22, slide: Farafra-6-2-2-4, cross-table number: 7.7/116.3.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clayey brown coal.

Derivatio nominis: In memoriam of Prof. Dr. R. POTONIÉ pioneer of the Pre-Quaternary Palynology.

Differential diagnosis: The smaller size, the thicker exine and in particular the endoaperture separates this taxon from *G. semiglobosus* (KEDVES 1963) KEDVES 1978.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (11) infrequent.

2. *Granotricolporites kirchheimerii* n. fsp.
(Plate 3.1., figs. 23,24)

Diagnosis: Generally isodiametric or ellipsoidal pollen grains. Surface granulate-reticulate, the size of the ornamental elements is 0.3 µm. The exine is 2-2.5 µm thick. The tectum, infratectum and the foot layer are of equal thickness; T/I/F = 1/1/1. The furrows do not reach the poles but they converge in the polar direction. The caverna is 1.8-2.5 µm thick. Endoapertures circular, and 2-3 µm in diameter.

Polar axis: 23 µm; 19-28 µm.

Holotype: Plate 3.1., figs. 23,24, slide: Abu Minquar-4-3-4, cross-table number: 7.3/108.4.

Locus typicus: Abu Minquar, Maestrichtian, Nubia Sandstone.

Stratum typicum: coaly clay.

Derivatio nominis: In honour of Prof. Dr. F. KIRCHHEIMER pioneer of the Pre-Quaternary Palynology of Africa.

Differential diagnosis: The larger size and the not so typical surface ornamentation separates this species from *G. potoniei* n. fsp.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Abu Minquar (4-3) infrequent.

3. *Granotricolporites druggii* n. fsp.
(Plate 3.1., figs. 25-30)

Diagnosis: Amb ellipsoidal. Surface granulate, but the tectum is sometimes perforated. The exine is 1.5-2.2 µm thick, the foot layer is relatively thick; T/I/F = 1/1/3-5.

Structure finely intrabaculate. The furrows are long, but in general do not reach the poles. The caverna is 2-2.8 μm thick. The endoapertures are usually 5 μm in diameter.

Polar axis: 28 μm; 25-30 μm.

Holotype: Plate 3.1., figs. 27,28, slide: Farafra-6-2-1-6, cross-table number: 14.4/106.3.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clay.

Derivatio nominis: In memoriam of Dr. W.S. DRUGG excellent investigator of the Pre-Quaternary sporomorphs.

Differential diagnosis: The very tiny sculptural elements, and the ellipsoidal ambitus separates this taxon from the previously described species.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) infrequent.

4. *Granotricolporites stanleyi* n. fsp.
(Plate 3.1., figs. 31,32)

Diagnosis: Amb ellipsoidal, surface finely granulate. Sometimes the ornamental elements anastomose. The exine is 0.7-1.3 μm thick. The tectum, infratectum and the foot layer are of equal thickness. Structure is not clearly discernible by optical microscopy but is probably granular. The furrows are long, but do not always reach the poles. The cavernae are 1-1.6 μm wide. Endopore circular and 2.5-3 μm in diameter.

Polar axis: 21 μm; 17-25 μm.

Holotype: Plate 3.1., figs. 31,32, slide: Abu Minquar-4-3-8, cross-table number: 17.2/115.6.

Locus typicus: Abu Minquar, Maestrichtian, Nubia Sandstone.

Stratum typicum: coaly clay.

Derivatio nominis: In honour of Dr. E.A. STANLEY, excellent investigator of the Upper Cretaceous and Tertiary sporomorphs.

Differential diagnosis: The narrower caverna separates this taxon from *G. druggii* n. fsp.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Abu Minquar (4-3) common.

Form-genus: *Punctatricolporites* n. fgen.

Form-genus type: *Punctatricolporites africanus* n. fgen. et fsp.
(Plate 3.1., figs. 33-36)

Diagnosis: Tricolporate pollen grains, surface punctate. Around the colpi there are cavernae.

Form-genus type: Plate 3.1., figs. 33,34, slide: Abu Minquar-4-3-6, cross-table number: 8.3/103.3.

Stratum typicum: coaly clay.

Derivatio nominis: From the most important morphological characteristic features.

Differential diagnosis: The punctate surface separates this taxon from the psilate or scabrate tricolporate pollen grains. *Magnopollis* KONZALOVÁ 1976 has a smooth or finely punctate surface. Moreover the pollen grains of KONZALOVÁ's (1976) genus are larger than those of our new form-genus.

1. *Punctatricolporites africanus* n. fsp.
(Plate 3.1., figs. 33-36)

Diagnosis: Amb ellipsoidal. Surface finely punctate. The exine is 1.2-1.6 μm thick. The tectum, infratectal layer and the foot layer are of equal thickness; T/I/F = 1/1/1. The structure is not clearly discernible by optical microscopy but is probably granular. The furrows are long, but in general do not reach the poles. The cavernae are 2-3 μm wide in the endoaperture region and become narrower in the polar direction. Endoapertures circular, 3-4 μm in diameter.

Polar axis: 22 μm; 20-26 μm.

Holotype, locus typicus, stratum typicum see previously.

Derivatio nominis: From Africa.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Abu Minquar (4-3).

2. *Punctatricolporites semipunctatus* n. fsp.
(Plate 3.1., figs. 37,38)

Diagnosis: Amb generally circular. Surface finely punctate but sometimes very finely reticulate. The exine is 0.6-0.8 μm thick. The infratectal layer is a little thicker than the tectum and the foot layer; T/I/F = 1/1.5-2/1. Structure finely intrabaculate. The furrows are long, but do not always reach the poles. They converge in the polar direction. The caverna is 1.8-2.3 μm wide. The endoapertures are 3-4 μm long. They consists of meridionally oriented furrows about 0.4 μm wide.

Diameter: 18 μm; 14-20 μm.

Holotype: Plate 3.1., figs. 37,38, slide: Farafra-6-2-2-7, cross-table number: 7.2/104.3.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clayey brown coal.

Derivatio nominis: From its peculiar sculpture.

Differential diagnosis: The smaller size, and the contour separates this species from *P. africanus* n. fsp.

Remarks: There are intermediate forms to *Retitricolporites aegypticus* KEDVES 1999, so it seems, that in this case, the sculpture type is not a particularly distinctive characteristic feature.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) infrequent.

3. *Punctatricolporites farafraensis* n. fsp.
(Plate 3.1., figs. 39,40)

Diagnosis: Amb ellipsoidal. Surface finely punctate. The exine is 0.8-1.4 μm thick. The infratectum is thicker than the tectum and the foot layer; T/I/F = 1/1.5-2/1. Structure intrabaculate. The furrows converge in the polar direction and usually reach the poles. The caverna is 1.5-2.5 μm in width. Endoapertures circular, and about 4 μm in diameter.

Polar axis: 24 μm; 19-26 μm.

Holotype: Plate 3.1., figs. 39,40, slide: Farafra-6-2-1-9; cross-table number: 9.4/111.8.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clay.
Derivatio nominis: From Farafra.
Differential diagnosis: The larger furrows, which converge in the polar area, and the narrower amb separates this taxon from *P. africanus* n. fsp.
Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-1) infrequent, Abu Minquar (4-3) infrequent.

Form-genus: *Psilatricolporites* VAN DER HAMMEN 1956 ex PIERCE 1961
Psilate, tricolporate pollen grains.

1. *Psilatricolporites magloirae* n. fsp.
(Plate 3.1., figs. 41-44)

Syn.: 1965 *Tricolporopollenites* sp. JARDINÉ and MAGLOIRE, p. 216, pl. 11, figs. 11-15.

Diagnosis: Amb circular to ellipsoidal, surface smooth. The exine is 1-1.3 µm thick. The infratectum is a little thicker, than the tectum and the foot layer; T/I/F = 1/1.5/1. Structure not clearly discernible by optical microscopy, probably finely intrabaculate. The furrows reach the poles, and converge in this direction. The caverna is 1-1.3 µm in width. The endoapertures are meridionally oriented short furrows, 0.8-1.2 µm wide and about 5 µm long.
Diameter: 17 µm; 16-19 µm.
Holotype: Plate 3.1., figs. 41,42, slide: Farafra-6-2-1-10, cross-table number: 4.9/114.3.
Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.
Stratum typicum: clay.
Derivatio nominis: In honour of Dr. L. MAGLOIRE excellent investigator of the Cretaceous sporomorphs of Africa.
Differential diagnosis: *T. debilis* GROOT, PENNY et GROOT 1961 is 16 x 13 µm in size, and has a psilate or faintly scabrate surface.
Remarks: Based on the documents of JARDINÉ et MAGLOIRE (1965, p. 216, pl. 11, figs. 11-15) this species occurs in the Turonian - Lower Senonian layers of Senegal, and in the Lower Senonian of the Ivory Coast.
Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) infrequent, Farafra (11) common, Abu Minquar (4-3) infrequent.

2. *Psilatricolporites aegypticus* n. fsp.
(Plate 3.1., figs. 45,46)

Diagnosis: Amb ellipsoidal, surface smooth. Exine is 0.6-0.8 µm thick. The tectum, infratectum and the foot layer are equal; T/I/F = 1/1/1. Structure is not clearly discernible by optical microscopy, probably finely granular. The furrows are long, but do not always reach the poles. The cavernae are 1.5 µm in width. The endoapertures consists of circular pori about 2 µm in diameter.
Polar axis: 18 µm; 16-20 µm.
Holotype: Plate 3.1., figs. 45,46, slide: Abu Minquar-4-3-5, cross-table number: 19.6/106.4.

Locus typicus: Abu Minquar, Maestrichtian, Nubia Sandstone.
Stratum typicum: coaly clay.
Derivatio nominis: From Egypt.
Differential diagnosis: The larger furrows, and the narrower cavernae separates this species from *P. gregussii* KEDVES 1978.
Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Abu Minquar (4-3) infrequent.

Form-genus: *Cupuliferoipollenites* R. POTONIÉ 1960
This form-genus circumscribes one group of psilate tricolporate pollen grains, the so-called "*Castaneoidae* types". SEM data from *C. cingulum* by POTTER (1976).

1. *Cupuliferoipollenites insleyanus* (TRAVERSE 1955) R. POTONIÉ 1960, *Fagaceae*, cf. *Castanea*
(Plate 3.1., figs. 47,48)

Description: Amb ellipsoidal, surface psilate. The exine is 0.6-0.8 µm thick and the three layers of the ectexine are of equal thickness; T/I/F = 1/1/1. Structure not clearly discernible by optical microscopy. The furrows reach the poles and the cavernae are 0.2-0.3 µm wide. Endopore circular, 1.5-2.5 µm in diameter.
Polar axis: 12 µm; 9-13 µm.
Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) common, Kharga (1-39) common.

2. *Cupuliferoipollenites* cf. *oviformis* (R. POTONIÉ 1931a) R. POTONIÉ 1960, *Fagaceae*, cf. *Castanea*
(Plate 3.1., figs. 49,50)

Description: Amb ellipsoidal, surface smooth. The exine is 1.2-1.4 µm thick. The tectum, infratectum and the foot layer are of equal thickness. The furrows do not always reach the poles. The cavernae near the endoapertures are about 2 µm wide and become narrower in the direction of the poles. Endoaperture, in general circular and about 3 µm in diameter.
Polar axis: 13 µm; 12-16 µm.
Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone (6-2-1) infrequent, Farafra (11) infrequent, Kharga (1-39) frequent, Kharga (1-28) infrequent.

3. *Cupuliferoipollenites pusillus* (R. POTONIÉ 1934) R. POTONIÉ 1960, *Fagaceae* cf. *Castanea*
(Plate 3.2., figs. 1,2)

Description: Amb ellipsoidal, surface smooth or finely scabrate. The exine is 0.8-1.2 µm thick. The tectum, infratectum and the foot layer are equal. The structure is not discernible by optical microscopy. The furrows generally reach the equator, the cavernae are 1.2-1.5 µm wide. The endopores are in general meridionally oriented ellipsoidal apertures, 3-3.5 µm in size.
Polar axis: 19 µm; 17-22 µm.

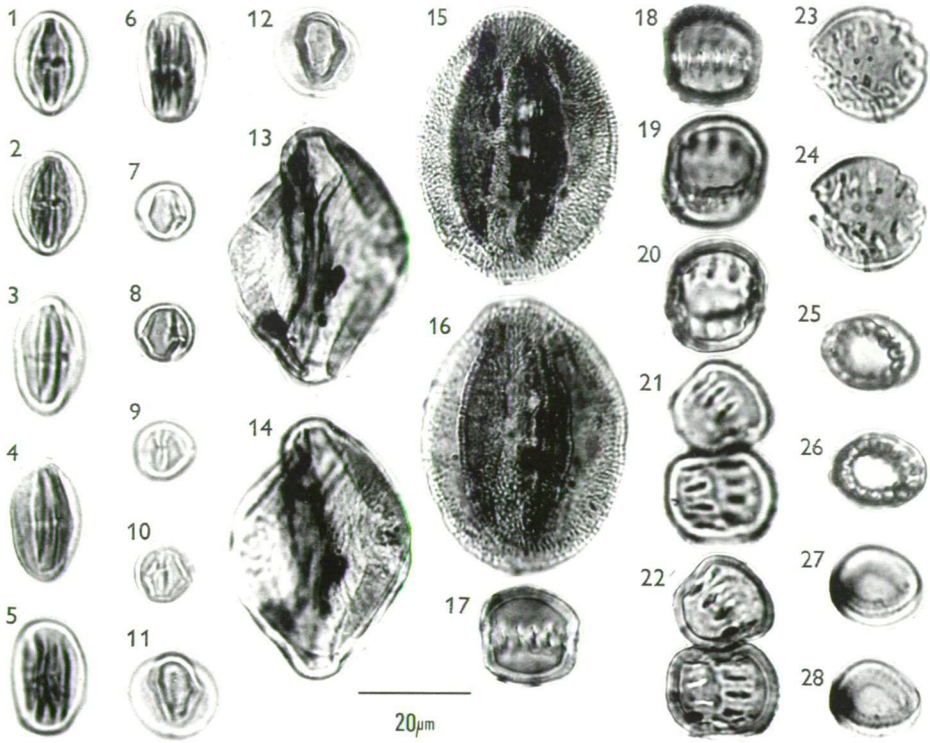

Plate 3.2.

1,2. *Cupuliferoipollenites pusillus* (R. POTONIÉ 1934) R. POTONIÉ 1960, *Fagaceae*, cf. *Castanea*, slide: Abu Minquar-4-3-3, cross-table number: 14.8/102.9.
3,4. *Fususpollenites fusus* (R. POTONIÉ 1934) KEDVES 1978, *Fagaceae, Castanopsis*, slide: Farafra-6-2-1-2, cross-table number: 13.5/114.6.
5,6. *Fususpollenites fusus* (R. POTONIÉ 1934) KEDVES 1978, *Fagaceae, Castanopsis*, slide: Abu Minquar-4-3-3, cross-table number: 10.5/117.4.
7,8. *Cyrillaceaepollenites exactus* (R. POTONIÉ 1931b) R. POTONIÉ 1960, *Cyrillaceae, Clethraceae* v. *Theaceae*, slide: Farafra-6-2-2-1, cross-table number: 4.6/109.6.
9.10. *Cyrillaceaepollenites exactus* (R. POTONIÉ 1931b) R. POTONIÉ 1960, *Cyrillaceae, Clethraceae* v. *Theaceae*, slide: Farafra-6-2-2-5, cross-table number: 11.1/111.8.
11,12. *Cyrillaceaepollenites megaexactus* (R. POTONIÉ 1931b) R. POTONIÉ 1960, *Cyrillaceae, Clethraceae* v. *Theaceae*, slide: Farafra-6-2-2-2. cross-table number: 18.7/100.6.
13,14. Cf. *Striatricolporites* fsp., slide: Kharga-1-28-1, cross-table number: 9.8/111.6.
15,16. *Nagyipollenites farafraensis* n. fsp., slide: Farafra-6-2-1-6, cross-table number: 17.3/112.6.
17,18. *Tubistephanocolpites schrankii* n. fsp., slide: Farafra-6-2-1-6, cross-table number: 104/106.8.
19,20. *Tubistephanocolpites schrankii* n. fsp., slide: Farafra-6-2-1-7, cross-table number: 10.1/112.6.
21,22. *Tubistephanocolpites schrankii* n. fsp., slide: Farafra-6-2-1-11, cross-table number: 6.3/110.7.
23,24. *Tubistephanocolpites cylindricus* SALAMI 1984, slide: Farafra-6-2-1-6, cross-table number: 4.1/102.8.
25,26. *Tubistephanocolpites* fsp., slide: Farafra-6-2-1-4, cross-table number: 4.2/109.5.
27,28. Cf. *Tubistephanocolpites* fsp., slide: Farafra-11-1, cross-table number: 12.2/103.2.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) common, Farafra (11) infrequent, Duwi Range (100) infrequent, Abu Minquar (4-3) infrequent, Kharga (1-39) infrequent, Kharga (1-28) frequent; Maestrichtian, fm. indet.: Oweina (3) common.

Form-genus: *Fususpollenites* KEDVES 1978
Tricolporate pollen grains, surface smooth, the structure is intrarugulate.

1. *Fususpollenites fusus* (R. POTONIÉ 1934) KEDVES 1978, *Fagaceae, Castanopsis*
(Plate 3.2., figs. 3-6)

Description: Amb ellipsoidal. Surface smooth to scabrate. The exine is 1.2-1.5 μm thick, the infratectum is a little thicker than the tectum and the foot layer; T/I/F = 1/1.5/1. Structure intrabaculate, or intrarugulate. The furrows reach the poles, and the cavernae are 1.5-2 μm in width. The endoapertures are meridionally oriented, ellipsoidal pores or short furrows: 3-4 x 2 μm.
Polar axis: 21 μm; 18-25 μm.
Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) infrequent, Abu Minquar (4-3) infrequent.

Form-genus: *Cyrillaceaepollenites* (MÜRRIGER et PFLUG 1951) R. POTONIÉ 1960
Psilate, tricolporate pollen grains, more or less spherical. The colpi are of the characteristic *Cyrillaceae, Clethraceae* or *Theaceae* (*Eurya*, etc.) type.

1. *Cyrillaceaepollenites exactus* (R. POTONIÉ 1931b) R. POTONIÉ 1960, *Cyrillaceae, Clethraceae* v. *Theaceae*
(Plate 3.2., figs. 7-10)

Description: Amb circular to ellipsoidal. Surface smooth. The exine is 0.8-1.2 μm thick. The tectum, infratectum, and the foot layer are of equal thickness. The furrows converge in the direction of the poles and usually reach the apices. The cavernae are 0.6-0.8 μm in width. The endoapertures are meridionally oriented short colpi, about 2 μm long, and 0.5 μm wide.
Diameter: 10 μm; 8-12 μm.
Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) dominant, Farafra (6-2-1) dominant, Farafra (11) dominant, Abu Minquar (4-3) dominant, Kharga (1-39) common, Kharga (1-28) common.

2. *Cyrillaceaepollenites megaexactus* (R. POTONIÉ 1931b) R. POTONIÉ 1960, *Cyrillaceae, Clethraceae* v. *Theaceae*
(Plate 3.2., figs. 11,12)

Description: Amb circular to ellipsoidal. Surface smooth to scabrate. The exine is 0.6-0.8 μm thick. The infratectum is a little thicker than the tectum and the foot layer. Structure finely intragranulate. The furrows generally reach, and fuse at the poles, and diverge in the endoapertural region to the ambitus. The cavernae are 1-1.2 μm wide, the endoapertures are short colpi, 0.4 x 3 μm in size.

Diameter: 15 µm; 13-17 µm.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) common, Farafra (11) frequent, Abu Minquar (4-3) frequent, Kharga (1-39) frequent, Kharga (1-28) frequent.

Form-genus: *Striatricolporites* (VAN DER HAMMEN 1956) LEIDELMEYER 1966

Striate, tricolporate pollen grains.

1. Cf. *Striatricolporites* fsp.
(Plate 3.2., figs. 13,14)

Description: Four lobed, tricolporate-tricolporoidate pollen grains. Surface striate and perforate. The exine is 0.8-1 µm thick on the sides, and 1.5-2 µm on the apices. The infratectal layer is a little, thicker than the tectum and the foot layer; T/I/F = 1/1.5/1. Because we have observed only one poorly preserved specimen, the condition of the apertural area was not suitable for exact morphological investigations.

Polar axis: 47 µm.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Kharga (1-28) infrequent.

Form-genus: *Nagyipollis* KEDVES 1962

Most important characteristic features of these pollen grains. The number of the colpi are three, and there are two or more endopori on one colpus.

1. *Nagyipollis farafraensis* n. fsp.
(Plate 3.2., figs. 15,16)

Diagnosis: Amb ellipsoidal, surface reticulate, the lumina of the reticulum are 0.6-1 µm. The exine is 1.5-2 µm thick. The infratectal layer is thickest between the exine layers; T/I/F = 1/2/1. The furrows in general do not reach the poles. The caverna is 2-3 µm wide. There are usually three endopori per furrow, circular and about 3 µm in diameter.

Polar axis: 47 µm; 43-50 µm.

Holotype: Plate 3.2., figs. 15,16, slide: Farafra-6-2-1; cross-table number: 17.3/112.6.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: aleurite.

Derivatio nominis: From Farafra.

Differential diagnosis: The relatively great size distinguishes this species from *N. globus* KEDVES 1962.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-1) infrequent, Abu Minquar (4-3) infrequent.

SUBTURMA: *PTYCHOPOLYPORINES* (*PTYCHOPOLYPORINA* NAUMOVA 1937, 1939) R. POTONIÉ 1960b

Form-genus: *Tubistephanocolpites* SALAMI 1984 emend. SCHRANK 1994

Polycolporate (12-15-20) pollen grains. The colpi are short and are usually about 1/4 or 1/3 the length of the polar axis, there are characteristic meridional "*cingulum*-like" thickening around the margin of the zone of the germinal apertures.

1. *Tubistephanocolpites schrankii* n. fsp.
(Plate 3.2., figs. 17-22)

Diagnosis: Polycolporate pollen grains, with cylindrical form, or ellipsoidal ambitus. Surface smooth or finely scabrate. The exine is 1.8-2.2 µm thick. Under the ectexine there is another separate layer, probably the endexine. The different ectexine layers, and the endexine are of equal thickness; T/I/F = 1/1/1. The fine structure of the infratectal layer is not discernible by optical microscopy but is probably granular. The number of the apertures is generally 12. The exoapertures are 4-5 µm long, and 0.5-0.8 µm wide. The endoapertures are 2.5-3 x 1.5 µm in size. The internal thickening at the margin of the apertural, zone is 1-1.2 µm wide, and 0.8-1.2 µm thick.

Polar axis: 17 µm; 16-20 µm.

Holotype: Plate 3.2., figs. 17,18, slide: Farafra-6-2-1-6, cross-table number: 10.4/106.8.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clay.

Derivatio nominis: From Dr. E. SCHRANK, excellent investigator of the Cretaceous palynomorphs of Sudan and Egypt.

Differential diagnosis: The thicker exine and the smaller size distinguishes this form-species from *T. cylindricus* SALAMI 1984.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-1) infrequent, Farafra (11) infrequent.

2. *Tubistephanocolpites cylindricus* SALAMI 1984
(Plate 3.2., figs. 23,24).

Description: One poorly preserved specimen occurred in our material which may be identical with the species from Senegal. Surface smooth or scabrate. The exine is 0.6-1 µm thick, endexine is not present based on the light microscope investigations. Tectum, infratectal layer and the foot layer are of equal thickness; T/I/F = 1/1/1. Structure finely intrabaculate. The number of the apertures is 12. The exoapertures are 4-6 µm wide. The size of the endoapertures is usually 2 µm. The germinal thickening is not characteristic. It is narrow and usually about 1 µm wide.

Maximum size: 20 µm.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-1) infrequent.

3. *Tubistephanocolpites* fsp.
(Plate 3.2., figs. 25,26)

Description: Several specimens of this pollen type occurred in our material, they were usually in a polar position so they are probably isodiametric. Surface scabrate or punctate. The exine is 1-1.3 µm thick, and composed only of ectexine. The three ectexine layers are of equal thickness; T/I/F = 1/1/1. The number of apertures is 12-14. They exhibit very characteristic internal thickenings around the apertural zone and the width of this thickened part is about 1 µm. The fine morphology of the apertures was not observed in our specimens because of the preferred orientation of the pollen grains.

Diameter: 12.5 µm.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-1) infrequent.

4. Cf. *Tubistephanocolpites* fsp.
(Plate 3.2., figs. 27,28)

Description: Only one poorly preserved specimen was found of this interesting pollen type. Surface punctate, the exine is 0.8-1.2 μm thick. The tectum, infratectal layer and the foot layer are of equal thickness; T/I/F = 1/1/1. The number of the apertures is 26, but the detailed morphology was not discernible in our specimen, there is however, a very characteristic apertural thickening.

Diameter: 16 μm.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (11) infrequent.

Remark. – The slides are deposited in the Cell Biological and Evolutionary Micropaleontological Laboratory of the Department of Botany of the J.A. University, Szeged, Hungary.

To be continued

Acknowledgements

This work was supported by Grant OTKA T/9 023208.

References

GROOT, J.J., PENNY, J.S. and GROOT, C.R. (1961): Plant microfossils and age of the Raritan Tuscaloosa and Magothy Formations of the Eastern United States. - Palaeontographica *B, 108,* 121-140.

GRUAS-CAVAGNETTO, C. (1979): Étude palynologique de l'Éocène du Sud de l'Angleterre. - Cahiers de Micropaléontol. *1,* 1-49.

HUANG, T.C. (1980): Miocene palynomorphs of Taiwan (V) - *Angiosperm* grains. - Taiwania *25,* 57-103.

JARDINÉ, S. et MAGLOIRE, L. (1965): Part I.

KEDVES, M. (1962): *Nagyipollis*, a new pollen fgen. from the Hungarian Lower Eocene. - Acta Biol. Szeged. *8,* 83-84.

KEDVES, M. (1963): Contribution à la flore Eocène inférieure de la Hongrie sur la base des examens palynologiques des couches houillères du puits III d'Oroszlány et du puits XV/b de Tatabánya. - Acta Bot. Acad. Sci. Hung. *9,* 31-66.

KEDVES, M. (1978): Part III.

KEDVES, M. (1999): Upper Cretaceous pollen grains from Egypt III. - Plant Cell Biology and Development (Szeged) *10,* 13-26.

KONZALOVÁ, M. (1976) Microbotanical (Palynological) research of the Lower Miocene of Northern Bohemia. - Rozpravy Ceskosl. Akad. Ved. (Prague) *86,* 5-75.

LEGOUX, O. (1978): Quelques espèces de pollen caractéristiques du Néogène du Nigeria. - Bull. Cent. Rech. Explor.-Prod. Elf-Aquitaine 2, 265-317.

LEIDELMEYER, P. (1966): Part I.

LOBREAU-CALLEN, D. (1975): Les variations dimensionelles du pollen du genre *Ilex (Aquifoliaceae)* et leurs rapports avec le climat. - Soc. bot. Fr., Coll. Palynologie 1975, 179-199.
MARTIN, H.A. (1977): The history of *Ilex (Aquifoliaceae)* with Special Reference to Australia: Evidence from Pollen. - Austr. J. Bot. *25*, 655-673.
MÜRRIGER, F. und PFLUG, H.D. (1951): Über die Altersstellung der Braunkohle von Burghasungen, Bezirk, Kassel, auf Grund pollenanalytischer Untersuchungen und Vergleich mit anderen Braunkohlenvorkommen. - Notizbl. Mess. L.-Amt. Bodenforsch. *6*, 87-97.
NAUMOVA, S. (1937): Part III.
PFLUG, H.D. und THOMSON (1953): In THOMSON und PFLUG.
PIERCE, R. L. (1961): Part II.
POTONIÉ, R. (1931a): Zur Mikroskopie der Braunkohlen. Tertiäre Blütenstaubformen. - Z. Braunkohle *30*, 325-333.
POTONIÉ, R. (1931b): Pollenformen der miozänen Braunkohle. - 2. Mitt. - Sitz.-Ber. naturf. Fr. Berlin, Jg. 1931 *1-3*, 24-27.
POTONIÉ, R. (1934): Part II.
POTONIÉ, R. (1960): Part III.
POTTER, F.W. jr. (1976): Part III.
RAATZ, G.V. (1937): Mikrobotanisch- stratigraphische Untersuchungen der Braunkohle des Muskauer Bogens. - Abh. Preuß. Geol. Landesanst. *183*, 1-48.
SALAMI, M.B. (1984): Three new sporomorph form genera from the Late Cretaceous and Paleogene of southwestern Nigeria. - Grana *23*, 163-166.
SAH, S.C.D. (1967): Palynology of an Upper Neogene profile from Rusizi Valley (Burundi). - Mus. Roy. Afr. Centr. Ann. *8*, 1-173.
SCHRANK, E. (1994): Palynology of the Yesomma Formation in Northern Somalia. A study of pollen, spores and associated phytoplankton from the Late Cretaceous *Palmae* Province. - Palaeontographica *B, 231*, 63-112.
THIERGART, F. (1937): Die Pollenanalyse der Niederlausitzer Braunkohle, besonders im Profil der Grube Marga bei Seftenberg. - Jb. Preuss. Geol. Landesanst. f. 1937, *58*, 282-351.
TRAVERSE, A. (1955): Pollen analysis of the Brandon lignite of Vermont. - US Dept. of the Int. Bur. Min. Rpt. of Invest. 5151, 1-107.
VAN DER HAMMEN, T. (1956): Part III.
VAN DER HAMMEN, T. and WIJMSTRA, T.A. (1964): Part III.